

General

Guideline Title

BTS guideline for oxygen use in adults in healthcare and emergency settings.

Bibliographic Source(s)

O'Driscoll BR, Howard LS, Earis J, Mak V, British Thoracic Society Emergency Oxygen Guideline Group, BTS Emergency Oxygen Guideline Development Group. BTS guideline for oxygen use in adults in healthcare and emergency settings. Thorax. 2017 Jun;72(Suppl 1):ii1-ii90. [494 references] [PubMed](#)

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

NEATS Assessment

National Guideline Clearinghouse (NGC) has assessed this guideline's adherence to standards of trustworthiness, derived from the Institute of Medicine's report [Clinical Practice Guidelines We Can Trust](#).

■■■■= Poor ■■■= Fair ■■■= Good ■■■= Very Good ■■■= Excellent

Assessment	Standard of Trustworthiness
YES	Disclosure of Guideline Funding Source
■■■■	Disclosure and Management of Financial Conflict of Interests
	Guideline Development Group Composition
YES	Multidisciplinary Group
YES	Methodologist Involvement

■■■■■	Patient and Public Perspectives
	Use of a Systematic Review of Evidence
■■■■■	Search Strategy
■■■■■	Study Selection
■■■■■	Synthesis of Evidence
	Evidence Foundations for and Rating Strength of Recommendations
■■■■■	Grading the Quality or Strength of Evidence
■■■■■	Benefits and Harms of Recommendations
■■■■■	Evidence Summary Supporting Recommendations
■■■■■	Rating the Strength of Recommendations
■■■■■	Specific and Unambiguous Articulation of Recommendations
■■■■■	External Review
■■■■■	Updating

Recommendations

Major Recommendations

The levels of evidence (1++, 1+, 1-, 2++, 2+, 2-, 3, 4), grades of recommendations (A-D), good practice points (GPPs), and recommendations for further research (RR) are defined at the end of the "Major Recommendations" field.

[Achieving Desirable Oxygen Saturation Ranges in Acute Illness \(see sections 6 and 8 and figures 1-2 in the original guideline document\)](#)

This guideline recommends aiming to achieve a normal or near-normal oxygen saturation for all acutely ill patients apart from those at risk of hypercapnic respiratory failure (grade D).

The recommended target saturation range for acutely ill patients not at risk of hypercapnic respiratory failure is 94% to 98% (grade D).

For most patients with known chronic obstructive pulmonary disease (COPD) or other known risk factors for hypercapnic respiratory failure (e.g., morbid obesity, cystic fibrosis [CF], chest wall deformities or neuromuscular disorders or fixed airflow obstruction associated with bronchiectasis), a target saturation range of 88% to 92% is suggested pending the availability of blood gas results (grade A for COPD, grade D for other conditions).

Most non-hypoxaemic breathless patients do not benefit from oxygen therapy, but a sudden reduction of $\geq 3\%$ in a patient's oxygen saturation within the target saturation range should prompt fuller assessment of the patient (and the oximeter signal) because this may be the first evidence of an acute illness (grade D).

Since oxygenation is reduced in the supine position, fully conscious hypoxaemic patients should

ideally be allowed to maintain the most upright posture possible (or the most comfortable posture for the patient) unless there are good reasons to immobilise the patient (e.g., skeletal or spinal trauma) (grade D).

Clinical and Laboratory Assessment of Hypoxaemia and Hypercapnia

Fully trained clinicians should assess all acutely ill patients by measuring respiratory rate, pulse rate, blood pressure and temperature and assessing circulating blood volume and anaemia (see section 7 in the original guideline document). Expert assistance from specialists in intensive care or from other disciplines should be sought at an early stage if patients are thought to have major life-threatening illnesses and clinicians should be prepared to call for assistance when necessary including a call for a 999 ambulance in prehospital care or a call for the resuscitation team or intensive care unit (ICU) outreach team in hospital care (grade D).

Oxygen saturation, 'the fifth vital sign', should be checked by trained staff using pulse oximetry in all breathless and acutely ill patients (supplemented by blood gases when necessary) and the inspired oxygen device and flow rate should be recorded on the observation chart with the oximetry result (grade D).

Initial clinical assessment and subsequent monitoring of acutely unwell patients should include the use of a recognised physiological 'track and trigger' system, such as the National Early Warning Score (NEWS) which may trigger clinical review due to hypoxaemia, need for supplementary oxygen or for other reasons (grade D).

For patients who are at risk of hypercapnic respiratory failure, it is recommended that the relevant section of the 2017 NEWS chart should be used. Points are awarded if the oxygen saturation is below or above the target range (grade D).

Good Practice Points for Clinical Assessment of Patients with Suspected Hypoxaemia

The medical history should be taken when possible in an acutely breathless patient and may point to the diagnosis of a particular acute illness such as pneumonia or pulmonary embolism or an exacerbation of a chronic condition such as COPD, asthma or heart failure.

Never discontinue oxygen therapy to obtain an oximetry measurement on room air in patients who clearly require oxygen therapy.

Physical examination should be undertaken urgently. This may provide evidence of a specific diagnosis such as heart failure or a large pleural effusion, but it is common for the cause of breathlessness to remain undiagnosed until the results of tests such as chest radiographs are available.

Record arterial oxygen saturation measured by pulse oximetry (SpO_2) and consider blood gas assessment in patients with unexplained confusion and agitation as this may be presenting feature of hypoxaemia and/or hypercapnia (cyanosis is a difficult physical sign to record confidently, especially in poor light or with an anaemic or plethoric patient).

Carefully measure respiratory rate and heart rate because tachypnoea and tachycardia are more common than a physical finding of cyanosis in hypoxaemic patients.

Appropriate changes should be made to any 'track and trigger' system used to allow for a lower target range in patients at risk of hypercapnic respiratory failure. These patients should score no EWS points for saturation if within their target range and they should score points if the oxygen saturation falls below the target range or if the saturation rises above the target range while breathing oxygen. The 2017 update of the NEWS chart has a special section for oximetry measurements for use with patients who have target range 88% to 92% and it is recommended that the 2017 NEWS chart should be used in all hospitals (see recommendation B4 in the original guideline document).

The presence of a normal SpO_2 does not negate the need for blood gas measurements especially if the patient is on supplemental oxygen therapy. Pulse oximetry will be normal in a patient with normal oxygen tension (PO_2) but abnormal blood pH or carbon dioxide tension (PCO_2) or with a low blood oxygen content due to anaemia. For this reason, blood gases and full blood count tests are required as early as possible in all situations where these measurements may affect patient

outcomes.

All clinical staff who use oximeters must be trained in their use and made aware of the limitations of oximetry. (Oximetry is a valuable clinical tool but subject to artefact and errors of interpretation.)

Arterial and Capillary Blood Gases

For critically ill patients or those with shock or hypotension (systolic blood pressure <90 mm Hg), the initial blood gas measurement should be obtained from an arterial sample (see sections 7.1.3, 8.4 and 8.5 in the original guideline document). For most patients who require blood gas sampling, either arterial blood gases (ABGs) or arterialised earlobe blood gases may be used to obtain an accurate measure of pH and PCO₂. However, the PO₂ is less accurate in earlobe blood gas samples (it underestimates the PO₂ by 0.5-1 kPa) so oximetry should be monitored carefully if earlobe blood gas specimens are used and a repeat arterial specimen should be taken if there is any concern about the accuracy of a capillary sample (grade D).

Local anaesthesia should be used for all ABG specimens except in emergencies (grade A).

Blood gases should be checked in the following situations:

- All critically ill patients (grade D).

- Unexpected or inappropriate fall in SpO₂ below 94% in patients breathing air or oxygen or any patient requiring oxygen to achieve the above target range. (Allowance should be made for transient dips in saturation to 90% or less in normal participants during sleep) (grade D).

- Deteriorating oxygen saturation (fall of ≥3%) or increasing breathlessness in a patient with previously stable chronic hypoxaemia (e.g., severe COPD) (grade D).

- Most previously stable patients who deteriorate clinically and require increased fraction of inspired oxygen (FiO₂) to maintain a constant oxygen saturation (grade D).

- Any patient with risk factors for hypercapnic respiratory failure who develops acute breathlessness, deteriorating oxygen saturation, drowsiness or other features of carbon dioxide retention (grade D).

- Patients with breathlessness who are thought to be at risk of metabolic conditions such as diabetic ketoacidosis or metabolic acidosis due to renal failure (grade D).

- Any other evidence from the patient's medical condition that would indicate that blood gas results would be useful in the patient's management (e.g., an unexpected change in 'track and trigger' systems such as a sudden rise of several units in the NEWS or an unexpected fall in oxygen saturation of 3% or more, even if within the target range) (grade D).

Good Practice Point: Patients Requiring Increased Concentration of Oxygen

The requirement for an increased concentration of oxygen is an indication for urgent clinical reassessment of the patient (and repeat blood gas measurements in most instances, see recommendations W13 and W18 in the original guideline document for exceptions).

Initial Oxygen Therapy; Initial Choice of Equipment for Patients Who Do Not Have Critical Illness

Initial oxygen therapy in critical illness is covered in the next section.

For acutely breathless patients not at risk of hypercapnic respiratory failure who have saturations below 85%, treatment should be started with a reservoir mask at 15 L/min in the first instance (see figures 1 and 2 [charts 1-2], table 2 and sections 8.9 and 10 in the original guideline document).^{*} The oxygen concentration can be adjusted downwards (using nasal cannulae at 1-6 L/min or a simple face mask at 5-10 L/min) to maintain a target saturation of 94% to 98% once the patient has stabilised (grade D).

In other cases of acute hypoxaemia without critical illness or risk factors for hypercapnic respiratory failure, treatment should be started with nasal cannulae (or a simple face mask if cannulae are not tolerated or not effective) with the flow rate adjusted to achieve a saturation of 94% to 98% (grade D).

If medium-concentration therapy with nasal cannulae or a simple face mask does not achieve the desired saturation, change to a reservoir mask and seek senior or specialist advice (grade D).

Good Practice Point

High-flow nasal oxygen using specialised equipment should be considered as an alternative to reservoir mask treatment in patients with acute respiratory failure without hypercapnia.

*For initial management of patients at risk of hypercapnic respiratory failure, see recommendations G1 and G2 in the original guideline document.

Oxygen Therapy in Critical Illness

Use the highest feasible inspired oxygen for ventilation during *cardiopulmonary resuscitation* (CPR; see table 1 and section 8.10 in the original guideline document). Once spontaneous circulation has returned and arterial blood oxygen saturation can be monitored reliably, aim for a target saturation range of 94% to 98% and take an ABG sample to guide ongoing oxygen therapy. If the blood gas shows hypercapnic respiratory failure, reset the target range to 88% to 92% or consider mechanical ventilation (grade D).

In *critical illness, including major trauma, sepsis, shock and anaphylaxis*, initiate treatment with a reservoir mask at 15 L/min and aim at a saturation range of 94% to 98%. This advice also applies to patients with critical illness who have risk factors for hypercapnia pending the results of blood gas measurements and expert assessment. In patients with spontaneous circulation and a reliable oximetry reading it may be possible to maintain a saturation of 94% to 98% using lower concentrations of oxygen (grade D).

In cases of *drowning*, aim at an oxygen saturation of 94% to 98% once spontaneous circulation is restored (grade D).

In patients with *acute seizures due to epilepsy or other causes*, high-concentration oxygen should be administered until a satisfactory oximetry measurement can be obtained and clinicians should then aim for an oxygen saturation of 94% to 98% or 88% to 92% if the patient is at risk of hypercapnic respiratory failure (grade D).

In cases of *major head injury*, aim at an oxygen saturation of 94% to 98%. Initial treatment should involve high-concentration oxygen from a reservoir mask at 15 L/min pending availability of satisfactory blood gas measurements or until the airway is secured by intubation (grade D).

In cases of *carbon monoxide poisoning*, an apparently 'normal' oximetry reading may be produced by carboxyhaemoglobin, so aim at an oxygen saturation of 100% and use a reservoir mask at 15 L/min irrespective of the oximeter reading and arterial oxygen tension (PaO₂) (grade D).

Oxygen Therapy for Specific Conditions That Frequently Require Oxygen Therapy

Respiratory Conditions with Low Risk of Hypercapnic Respiratory Failure

In *acute asthma*, aim at an oxygen saturation of 94% to 98% (see tables 2 and 3 and sections 8.11 and 8.13 in the original guideline document) (grade D).

In cases of *pneumonia* who are not at risk of hypercapnic respiratory failure, aim at an oxygen saturation of 94% to 98% (grade D).

In acute *breathlessness due to lung cancer*, aim at an oxygen saturation of 94% to 98% unless there is coexisting COPD. See also "Oxygen Use in Palliative Care," section 8.17 in the original guideline document (grade D).

In *acute deterioration of pulmonary fibrosis or other interstitial lung diseases*, aim at an oxygen saturation of 94% to 98% or the highest possible if these targets cannot be achieved (grade D).

In most cases of *pneumothorax*, aim at an oxygen saturation of 94% to 98% if the patient is not at risk of hypercapnic respiratory failure (grade D).

In patients with *pneumothorax* having hospital observation without drainage, the use of high-concentration oxygen (15 L/min flow rate via reservoir mask) is recommended unless the patient is at risk of hypercapnic respiratory failure (grade D).

In *pleural effusion*, aim at an oxygen saturation of 94% to 98% (or 88% to 92% if the patient is at risk of hypercapnic respiratory failure) (grade D).

In *pulmonary embolism*, aim at an oxygen saturation of 94% to 98% (or 88% to 92% if the patient

is at risk of hypercapnic respiratory failure) (grade D).

Non-respiratory Conditions

In *acute heart failure*, aim at an oxygen saturation of 94% to 98% (or 88% to 92% if the patient is at risk of hypercapnic respiratory failure) (grade D).

Continuous positive airway pressure (CPAP) with entrained oxygen or high-flow humidified nasal oxygen to maintain saturation 94% to 98% (or 88% to 92% if at risk of hypercapnia) should be considered as an adjunctive treatment to improve gas exchange in patients with cardiogenic pulmonary oedema who are not responding to standard treatment (or non-invasive ventilation (NIV) if there is coexistent hypercapnia and acidosis) (grade B).

In *anaemia*, aim at an oxygen saturation of 94% to 98% or 88% to 92% if the patient is at risk of hypercapnic respiratory failure (grade D).

Good Practice Point: Correction of anaemia by blood transfusion should be based on national guidelines.

In *sickle cell crisis* and acute chest syndrome, aim for an oxygen saturation of 94% to 98% or aim at the saturation level that is usual for the individual patient (grade D).

Good Practice Point Regarding Sickle Cell Crisis: Arterial or arterialised capillary blood gases should be sampled if there is any doubt about the reliability of oximetry during a sickle cell crisis.

In *myocardial infarction and acute coronary syndromes*, aim at an oxygen saturation of 94% to 98% or 88% to 92% if the patient is at risk of hypercapnic respiratory failure (grade D).

High concentrations of oxygen should be avoided in *patients with stroke*, unless required to maintain normal oxygen saturation. Aim at an oxygen saturation of 94% to 98% or 88% to 92% if the patient is at risk of hypercapnic respiratory failure (grade D).

Good Practice Points Regarding Stroke Management:

Oxygen saturation should be monitored at least every 4 hours throughout the day and night in patients with acute stroke and all episodes of hypoxaemia treated.

Patients with hypoxaemia post-stroke require medical review to establish and treat the cause.

Oxygen should only be given once the airway has been cleared and at the lowest concentration necessary to achieve an oxygen saturation of 94% to 98% or 88% to 92% if the patient is at risk of hypercapnic respiratory failure.

Oxygen should be given via nasal cannulae, unless there are clear indications for a different oxygen delivery system.

Patients with stroke and cardiorespiratory comorbidities should be positioned as upright as possible, in a chair if possible (see recommendation A5 in the original guideline document).

Patients with a reduced level of consciousness after stroke should be nursed in the recovery position with the paralysed side lowest.

Good Practice Points Regarding Patients with Suspected Hyperventilation:

Organic illness must be excluded before making a diagnosis of hyperventilation.

Patients with a definite diagnosis of hyperventilation should have their oxygen saturation monitored. Those with normal or high SpO₂ do not require oxygen therapy.

Rebreathing from a paper bag can be dangerous and is NOT advised as a treatment for hyperventilation.

In *most poisonings*, aim at an oxygen saturation of 94% to 98% unless the patient is at risk of hypercapnic respiratory failure (grade D).

In *poisoning by paraquat and poisoning by bleomycin*, give oxygen only if the saturation falls below 85% and reduce or stop oxygen therapy if the saturation rises above 88% (grade D).

In most *metabolic and renal disorders*, aim at an oxygen saturation of 94% to 98% unless the patient is at risk of hypercapnic respiratory failure (grade D).

For patients with *cluster headaches*, oxygen should be administered using a flow of at least 12 L/min from a reservoir mask and home oxygen should be provided (grade D).

Patients at Risk of Hypercapnic Respiratory Failure (see table 4 and section 8.12 in the original guideline document)

For most patients with known COPD or other known risk factors for hypercapnic respiratory failure (e.g., morbid obesity, CF, chest wall deformities or neuromuscular disorders or fixed airflow obstruction associated with bronchiectasis), a target saturation range of 88% to 92% is suggested pending the availability of blood gas results (grade A for COPD, grade D for other conditions). Some patients with COPD and other conditions are vulnerable to repeated episodes of hypercapnic respiratory failure. In these cases it is recommended that treatment should be based on the results of previous blood gas estimations during acute exacerbations. For patients with prior hypercapnic failure (requiring NIV or intermittent positive pressure ventilation) who do not have an alert card, it is recommended that low-concentration oxygen treatment should be started using a 24% Venturi mask at 2-3 L/min (or a 28% Venturi mask at 4 L/min or nasal cannulae at 1-2 L/min if a 24% mask is not available) with an initial target saturation of 88% to 92% pending urgent blood gas results. These patients should be treated as a high priority by emergency services and the oxygen concentration should be reduced if the saturation exceeds 92% but increased if it falls below 88% (grade D).

Good Practice Points for COPD and Other Conditions That May Cause Hypercapnic Respiratory Failure

Diagnosis of COPD or Suspected Exacerbation of COPD

If the diagnosis is unknown, patients over 50 years of age who are long-term smokers with a history of chronic breathlessness on minor exertion such as walking on level ground and no other known cause of breathlessness should be treated as having suspected COPD for the purposes of this guideline.

Spirometry should be measured at least once during hospital admissions for suspected COPD (as per National Institute of Health and Care Excellence [NICE] COPD guideline). Measurement of spirometry may confirm (or exclude) a diagnosis of airflow obstruction and the forced expiratory volume in 1 s (FEV₁) level is a useful indicator of disease severity in COPD.

Immediate Management of Patients with Known or Suspected COPD

If the saturation remains below 88% in prehospital care despite a 28% Venturi mask, change to nasal cannulae at 2-6 L/min or a simple face mask at 5 L/min with target saturation of 88% to 92% and alert the accident and emergency (A&E) department that the patient is to be treated as a high priority.

Patients with a respiratory rate >30 breaths/min should have the flow rate from Venturi masks set above the minimum flow rate specified for the Venturi mask packaging to compensate for the patient's increased inspiratory flow (see figure 11B in the original guideline document). Increasing the oxygen flow rate into a Venturi mask does not increase the concentration of oxygen which is delivered.

Patients with a significant likelihood of severe COPD or other illness that may cause hypercapnic respiratory failure should be triaged as very urgent on arrival in hospital emergency departments and blood gases should be measured on arrival in hospital.

Prior to availability of blood gas measurements, use a 24% Venturi mask at 2-3 L/min or nasal cannulae at 1-2 L/min or 28% Venturi mask at 4 L/min and aim for an oxygen saturation of 88% to 92%.

Initial Hospital Management of Patients with Exacerbation of COPD

Patients with exacerbations of COPD need careful monitoring for hypercapnic respiratory failure with respiratory acidosis which may develop in the course of a hospital admission even if the initial blood gases were satisfactory.

Avoid excessive oxygen use in patients with COPD. The risk of respiratory acidosis in patients with hypercapnic respiratory failure is increased if the PaO₂ is above 10.0 kPa due to previous excessive oxygen use.

If following blood gas measurements the pH and PCO₂ are normal, aim for an oxygen saturation of 94% to 98% unless there is a history of previous hypercapnic respiratory failure requiring NIV or

intermittent positive pressure ventilation or if the patient's usual oxygen saturation when clinically stable is below 94% (these patients should have a target range of 88% to 92%). Blood gases should be repeated at 30 to 60 min to check for rising PCO₂ or falling pH.

Recheck blood gases after 30 to 60 min (or if there is evidence of clinical deterioration) for all patients with COPD or other risk factors for hypercapnic respiratory failure even if the initial PCO₂ measurement was normal.

If the PCO₂ is raised but pH is ≥ 7.35 ($[H^+] \leq 45$ nmol/L) and/or a high bicarbonate level (>28 mmol/L), the patient has probably got long-standing hypercapnia; maintain target range of 88% to 92% for these patients. Blood gases should be repeated at 30 to 60 min to check for rising PCO₂ or falling pH.

If the patient is hypercapnic (PCO₂ >6 kPa or 45 mm Hg) and acidotic (pH <7.35 or $[H^+] >45$ nmol/L), start NIV with targeted oxygen therapy if respiratory acidosis persists for more than 30 min after initiation of standard medical management.

For patients using Venturi masks, consider changing from Venturi mask to nasal cannulae once the patient has stabilised.

For patients who use long-term home oxygen (LTOT) for severe COPD, a senior clinician should consider setting a patient-specific target range if the standard range of 88% to 92% would require inappropriate adjustment of the patient's usual oxygen therapy while the patient is in hospital.

Good Practice Points: Management of Hypercapnia or Respiratory Acidosis Due to Excessive Oxygen Therapy (Avoidance of Life-threatening Rebound Hypoxaemia)

If a patient is suspected to have hypercapnic respiratory failure due to excessive oxygen therapy, the oxygen therapy must be stepped down to the lowest level required to maintain a saturation range of 88% to 92%. This may be achieved using 28% or 24% oxygen from a Venturi mask or 1-2 L/min via nasal cannulae depending on oxygen saturation and subsequent blood gas measurements.

Sudden cessation of supplementary oxygen therapy can cause life-threatening rebound hypoxaemia with a rapid fall in oxygen saturations below the starting oxygen saturation prior to the start of supplementary oxygen therapy.

Initial oxygen treatment of *CF exacerbations* should be similar to the initial oxygen treatment of COPD exacerbations with target saturation 88% to 92% (see sections 8.12.1-8.12.2 in the original guideline document; grade D).

In the initial management of *musculoskeletal and neurological disorders* with acute respiratory failure or acute-on-chronic respiratory failure, aim at an oxygen saturation of 88% to 92% and measure blood gases to determine if NIV will be required (grade D).

Good Practice Point Regarding Patients with Neurological Disorders: Patients with respiratory failure due to neurological disorders or muscle disease are at high risk of dying and require urgent assessment to determine if they are likely to require noninvasive or invasive ventilator support rather than oxygen therapy. Monitor these patients with blood gases and regular spirometry (forced vital capacity). Patient's wishes regarding this form of treatment should be established as early as possible in the course of the illness, ideally before an acute episode has developed.

Morbidly obese patients (body mass index [BMI] >40 kg/m²), even without evidence of coexistent obstructive sleep apnoea (OSA) are at risk of hypoventilation and should be given titrated oxygen to maintain a target saturation of 88% to 92% (grade D).

NIV should be considered for hypercapnic patients with COPD, CF, neuromuscular disorders or morbid obesity who are at risk of hypercapnic respiratory failure if the pH is <7.35 or $[H^+] >45$ nmol/L (grade D). See the National Guideline Clearinghouse (NGC) summary of the BTS/Intensive Care Society (ICS) [Guideline for the ventilatory management of acute hypercapnic respiratory failure](#)

Oxygen Use During Pregnancy (see section 8.14 in the original guideline document)

Women who suffer from major trauma, sepsis or acute illness during pregnancy should receive the same oxygen therapy as any other seriously ill patients, with a target oxygen saturation of 94% to 98%. The same target range should be applied to women with hypoxaemia due to acute

complications of pregnancy (e.g., collapse related to amniotic fluid embolus, eclampsia or antepartum or postpartum haemorrhage) (grade D).

Women with underlying hypoxaemic conditions (e.g., heart failure) should be given supplemental oxygen during labour to achieve an oxygen saturation of 94% to 98% unless they are at risk of hypercapnic respiratory failure (target range 88% to 92%) (grade D).

Pregnant women who are fully conscious with no cardiovascular compromise may be managed in the sitting position or if lying down should use the full left lateral position (grade D).

Pregnant women above 20 weeks gestation (uterine fundus at or above the level of the umbilicus) who are *at risk of developing associated cardiovascular compromise* (e.g., trauma, vaginal bleeding, etc.) should be positioned to avoid aortocaval compression by using left lateral tilt, manual uterine displacement or by placing them in a full left lateral position (grade D).

Women who are more than 20 weeks pregnant *with evidence of hypoxaemia* associated with reduced consciousness or those requiring respiratory or cardiovascular support or CPR should be managed with left lateral tilt or manual uterine displacement (ideally to the left) to improve cardiac output and oxygen delivery (grade D).

The use of oxygen supplementation during intrauterine fetal resuscitation during labour was widespread in the past but there is no evidence of benefit. There is weak evidence of harm to the fetus if supplemental oxygen is given for long periods during uncomplicated labour. Overall, the use of oxygen during labour is only required when there is evidence of maternal hypoxaemia (oxygen saturation <94%) (grade D).

Oxygen Use in Perioperative Care and During Procedures Requiring Conscious Sedation (see sections 8.15-8.16 and 10.11 in the original guideline document)

Hyperoxaemia is not recommended routinely in the perioperative and postoperative period to reduce the incidence of postoperative nausea and vomiting (grade D).

All procedures involving conscious sedation warrant routine continuous monitoring of oxygen saturation via pulse oximetry prior to and during the procedure, and in the recovery period, particularly fibre optic bronchoscopy and upper gastrointestinal (GI) endoscopy where a reduction in arterial oxygen saturation (SaO₂) is common, particularly with concurrent use of sedation (grade C).

Significant arterial oxygen desaturation (SpO₂ <90% or fall of 4% or more that is prolonged [>1 min during endoscopy procedures]) should be corrected by supplemental oxygen with the aim of achieving target oxygen saturations of 94% to 98%, or 88% to 92% in those at risk of hypercapnic respiratory failure (grade D).

Complicated upper GI endoscopy or procedures in patients with cardiorespiratory comorbidity are especially likely to lead to hypoxaemia and may also lead to hypercapnia, especially if the patient is heavily sedated. It is recommended that blood gases should be measured if such patients should require prolonged oxygen administration. The routine administration of oxygen is not recommended as it may delay the recognition of respiratory failure (grade D).

Constant clinical assessment of the patient is crucial at all stages of conscious sedation procedures and monitoring of capnography or transcutaneous carbon dioxide levels may be a useful adjunct to identify early respiratory depression (grade D).

During the recovery period after procedures requiring conscious sedation, supplemental oxygen should be titrated to achieve target saturations of 94% to 98% in most patients and 88% to 92% in those at risk of hypercapnic respiratory failure (see section 10.5.1 in the original guideline document) (grade D).

Good Practice Points Related to Oxygen Use in Perioperative Care

A target saturation of 94% to 98% is recommended for most surgical patients except those at risk of hypercapnic respiratory failure when a range of 88% to 92% should be achieved.

Pulse oximetry monitoring is recommended for postoperative patients despite the lack of evidence from randomised studies.

Patients using *patient controlled analgesia* (PCA) should have two-hourly oximetry observations because of the risk of hypoxaemia. Oxygen should be administered to keep patients within the

appropriate target saturation range.

A target saturation of 94% to 98% is advised in most patients having PCA except those at risk of hypercapnic respiratory failure when a range of 88% to 92% should be achieved.

There is conflicting evidence concerning the balance of potential benefits and risks of *perioperative hyperoxaemia to reduce the risk of surgical site infection in elective surgery* and there is no evidence for this practice in patients having emergency surgical procedures. More trials are required for specific procedures and more information is required concerning long-term mortality risks to patients with cancer. In the meantime, oxygen should not be used for this indication outside of clinical trials.

Oxygen Use in Palliative Care (see section 8.17 in the original guideline document)

Oxygen use in palliative care patients should be restricted to patients with SpO₂ consistently <90% or patients who report significant relief of breathlessness from oxygen. In nonhypoxaemic patients, opioids and non-pharmacological measures should be tried before oxygen (grade B).

In general, there is no role for the monitoring of oxygen saturation or PaO₂ in comfort-focused care in the last few days of life. If the patient appears comfortable, oxygen levels are irrelevant and should not influence care (grade D).

Good Practice Points Related to Oxygen Use in Palliative Care

Oxygen therapy for the symptomatic relief of breathlessness in palliative care patients is more complex than the simple correction of hypoxaemia. Consider the following issues:

Consider early involvement of palliative care specialists and physiotherapists;

As breathlessness is a multifactorial sensation—a comprehensive assessment of contributing factors (such as anxiety) should be carried out.

Low-dose opioids should be considered because they are effective for the relief of breathlessness in palliative care patients.

A trial of a hand held fan to help relieve breathlessness is recommended prior to trial of oxygen.

Oxygen use has to be tailored to the individual and a formal assessment made of its efficacy for reducing breathlessness and improving quality of life for that person.

Oxygen therapy should not be continued in the absence of patient benefit or where its disadvantages (e.g., discomfort of masks or nasal cannulae, drying of mucous membranes) outweigh any likely symptomatic benefit.

Mixtures of Oxygen with Other Gases (Heliox and Entonox)

Use of Helium–Oxygen Mixtures (Heliox) (see section 8.18 in the original guideline document)

There is insufficient evidence to support the use of Heliox either as an inhaled gas or as the driving gas for nebuliser therapy in adult patients with acute exacerbations of asthma or acute exacerbations of COPD (AECOPD) except as part of randomised clinical trials or in exceptional circumstances (grade D).

A therapeutic trial of Heliox is reasonable in patients with mechanical upper airway obstruction or postoperative stridor (grade D).

Heliox use for patients with asthma or COPD should be considered only in clinical trials or in specialist hands for severe exacerbations that are not responding to standard treatment (and in patients with COPD where there are contraindications to intubation) (grade D).

Use of Nitrous Oxide/Oxygen Mixtures (Entonox) for Analgesia (see section 9.11 in the original guideline document)

The use of Entonox gas mixture for analgesia should be avoided if possible in patients at risk of hypercapnic respiratory failure (grade D).

CPAP and Humidified High-flow Nasal Oxygen

Use of CPAP in the Perioperative Period and for Pulmonary Oedema (see section 8.19 in the original

guideline document)

Patients with diagnosed sleep-disordered breathing established on CPAP undergoing surgery should bring their machines with them and use them in the preoperative and postoperative period. If adequate saturations are not achieved despite CPAP therapy then assess for worsening ventilation with blood gases and oxygen should be entrained to achieve a saturation of 88% to 92% (grade D). CPAP with entrained oxygen to maintain saturation 94% to 98% should be considered as an adjunctive treatment to improve gas exchange in patients with cardiogenic pulmonary oedema who are not responding to standard treatment in hospital care or in prehospital care (grade B).

Good Practice Point, High-flow Humidified Nasal Oxygen via Nasal Cannulae

High-flow humidified nasal oxygen should be considered as a potentially superior alternative to reservoir mask treatment in patients with acute respiratory failure without hypercapnia.

Patients with Tracheostomy or Laryngectomy (see section 10.3 in the original guideline document)

When oxygen is required by patients with prior tracheostomy or laryngectomy, a tracheostomy mask (varying the flow as necessary) should achieve the desired oxygen saturation (see tables 1-4 in the original guideline document). An alternative delivery device, usually a T-piece device fitted directly to the tracheostomy tube, may be necessary if the patient deteriorates (grade D).

Humidification of Oxygen (see section 10.2 in the original guideline document)

Humidification is not required for the delivery of low-flow oxygen (mask or nasal cannulae) or for the short-term use of high-flow oxygen. It is not therefore required in prehospital care. Pending the results of clinical trials, it is reasonable to use humidified oxygen for patients who require high-flow oxygen systems for more than 24 hours or who report upper airway discomfort due to dryness (grade D).

In the emergency situation, humidified oxygen use can be confined to patients with tracheostomy or an artificial airway although these patients can be managed without humidification for short periods of time (e.g., ambulance journeys) (grade D).

Humidification may also be of benefit to patients with viscous secretions causing difficulty with expectoration. This benefit can be achieved using nebulised normal saline (grade D).

Bubble bottles which allow a stream of oxygen to bubble through a container of water should not be used because there is no evidence of a clinically significant benefit but there is a risk of infection (grade D).

Good Practice Points Related to Humidified Oxygen Therapy

Consider use of a large volume oxygen humidifier device for patients requiring high-flow rates or longer term oxygen, especially if sputum retention is a clinical problem.

In the absence of an artificial airway the decision to humidify supplemental oxygen needs to be made on an individual basis but this practice is not evidence-based.

Driving Gas for Nebulised Treatments (see section 10.4 in the original guideline document)

For patients with asthma, nebulisers should be driven by piped oxygen or from an oxygen cylinder fitted with a high-flow regulator capable of delivering a flow rate of >6 L/min. The patient should be changed back to his/her usual oxygen mask or cannulae when nebuliser therapy is complete. If the cylinder does not produce this flow rate, an air-driven nebuliser (with electrical compressor) should be used with supplemental oxygen by nasal cannulae at 2-6 L/min to maintain an appropriate oxygen saturation level (grade D).

When nebulised bronchodilators are given to patients with hypercapnic acidosis, they should be given using an ultrasonic nebuliser or else a jet nebuliser driven by compressed air and, if necessary, supplementary oxygen should be given concurrently by nasal cannulae to maintain an oxygen saturation of 88% to 92%. The same precautions should be applied to patients who are at risk of hypercapnic respiratory failure prior to the availability of blood gas results and the oxygen saturation

should be monitored continuously during treatment. Once the nebulised treatment is completed for patients at risk of hypercapnic respiratory failure, their previous targeted oxygen therapy should be reinstituted (grade D).

Good Practice Points

Do not allow hypoxaemia to occur while administering nebulised treatments:

For hypoxaemic patients, oxygen therapy should continue during nebulised treatments.

Driving gas for nebulized treatment in ambulances:

During treatment by ambulance staff oxygen-driven nebulisers should be used for patients with asthma and may be used for patients with COPD in the absence of an air-driven compressor system. If oxygen is used for patients with known COPD, its use should be limited to 6 min. This will deliver most of the nebulised drug dose but limit the risk of hypercapnic respiratory failure (section 10.4 in the original guideline document). Ambulance services are encouraged to explore the feasibility of introducing battery-powered, air-driven nebulisers or portable ultrasonic nebulisers.

Prescribing Oxygen Therapy (see section 11 in the original guideline document)

Every healthcare facility should have a standard oxygen prescription document or, preferably, a designated oxygen section on all drug-prescribing cards or guided prescription of oxygen in electronic prescribing systems (grade D).

A prescription for oxygen should always be provided, except in sudden illness when it must be started immediately and documented retrospectively (grade D).

Doctors and other prescribers should prescribe oxygen using a target saturation range (sections 8, 9 and 11 in the original guideline document) and sign the drug chart or electronic prescribing order (grade D).

An oxygen target saturation range should be prescribed for all patients who are admitted to hospital. This will ensure that every patient will receive appropriate oxygen therapy if it should be required. It will also ensure that all clinicians are aware of the appropriate oxygen target range for every patient under their care (grade D).

Good Practice Points Related to Prescribing and Administering Oxygen Therapy to Patients

Oxygen should be prescribed on the drug chart or electronic prescribing system using a target saturation range.

Oxygen should be prescribed to a target saturation range rather than prescribing a fixed concentration of oxygen or FiO_2 (see recommendations A1, A2, A4, and A5 in the original guideline document).

In most emergency situations, oxygen is given to patients immediately without a formal prescription. The lack of a prescription should never preclude oxygen being given when needed in an emergency situation. However, a subsequent written record must be made of what oxygen therapy has been given to every patient in a similar manner to the recording of all other emergency treatment.

If a patient has an oxygen alert card (see the "Availability of Companion Documents" field), initial oxygen therapy should be based on the guidance on the card until the results of blood gases are available.

Monitoring and Adjusting Oxygen Therapy (see sections 9-11 in the original guideline document)

Pulse oximetry must be available in all locations where emergency oxygen is being used by healthcare professionals (see also the limitations of using pulse oximetry section 7.1.2 in the original guideline document) (grade D).

All documents which record oximetry measurements or blood gas results should state whether the patient is breathing air or a specified oxygen delivery device and flow rate using the abbreviations shown in table 5 in the original guideline document (grade D).

In all situations where repeated blood gas measurements are required, they should be measured as

soon as possible, usually within 30 min of any treatment change, to determine if the proposed target saturations are appropriate. Consider the use of an indwelling arterial catheter if multiple samples are likely to be required (grade D).

Adjustments should only be made by registered staff who have been trained to administer oxygen. If the oxygen saturation falls below the prespecified range, the concentration of oxygen should be increased; if the saturation rises above this range, the oxygen concentration should be reduced. If the monitoring of oxygen saturation is performed by unregistered staff (e.g., healthcare assistants), there must be a clear protocol in place which requires that they should inform staff who are trained to administer oxygen if the oxygen saturation is above or below the target saturation (grade D).

Good Practice Points Related to Administration of Oxygen Therapy

For hypoxaemic patients, oxygen therapy should continue during other treatments such as nebulised therapy. Clinicians should assess the clinical status of the patient prior to prescribing oxygen and the patient's condition should be reassessed frequently during oxygen use (see recommendations B1-B3 in the original guideline document).

The administering healthcare professional should note the oxygen saturation before starting oxygen therapy whenever possible but never discontinue or delay oxygen therapy for seriously ill patients (see recommendation B2 in the original guideline document).

The healthcare professional should start oxygen therapy using an appropriate delivery system and flow rate as specified in sections 8 to 10 of the original guideline document. The target oxygen saturation should be documented on the respiratory section of the observation chart.

Whenever possible, patients should be given an oxygen information sheet (see example in Web appendix 6 [see the "Availability of Companion Documents" field]).

Staff should check the oxygen supply and connections on a regular basis because there have been serious incidents due to disconnection or misconnection of oxygen supplies.

Staff must ensure that adequate oxygen is provided during transfers and while patients are in diagnostic departments. Additionally, oxygen saturation should be monitored continuously for seriously ill patients who require escorted transfers. This is because there have been serious incidents involving accidental discontinuation of oxygen or cylinders running out during interward transfers or transfers to other departments such as for x-rays.

Weaning and Discontinuation of Oxygen Therapy

Lower the oxygen concentration if the patient is clinically stable and the oxygen saturation is above the target range or if it has been in the upper zone of the target range for some time (usually 4 to 8 hours) (grade D).

If the target saturation is maintained, the new delivery system and flow should be continued. Repeat blood gas measurements are not required. If the patient is stable the process can be repeated and the patient can eventually be weaned off oxygen (see section 12 in the original guideline document) (grade D).

Most stable convalescent patients will eventually be stepped down to 2 L/min via nasal cannulae prior to cessation of oxygen therapy. Patients at risk of hypercapnic respiratory failure may be stepped down to 1 L/min (or occasionally 0.5 L/min) via nasal cannulae or a 24% Venturi mask at 2 L/min as the lowest oxygen concentration prior to cessation of oxygen therapy (grade D).

Oxygen therapy should be stopped once a patient is clinically stable on low-concentration oxygen and the oxygen saturation is within the desired range on two consecutive observations (but the prescription for a target saturation range should remain active in case of future deterioration). It may be appropriate to alter the target range following senior review in patients with chronic cardiopulmonary disease who either have saturations <94% when stable or in whom it is deemed sensible to discharge from hospital with saturations <94% pending an outpatient oxygen assessment. Oxygen should also be stopped if the patient has come to the end of a written protocol of timed oxygen (e.g., postoperatively) (grade D).

Oxygen saturation on air should be monitored for 5 min after stopping oxygen therapy. If it remains in the desired range it should be rechecked at 1 hour (grade D).

If the oxygen saturation and physiological 'track and trigger' score (e.g., NEWS) is satisfactory at 1

hour, the patient has safely discontinued oxygen therapy. However, saturation and physiology should continue to be monitored on a regular basis according to the patient's underlying clinical condition (grade D).

If the saturation falls below the patient's target range on stopping oxygen therapy, restart the lowest concentration that maintained the patient in the target range and monitor for 5 min. If this restores the saturation into the target range, continue oxygen therapy at this level and attempt discontinuation of oxygen therapy again at a later date provided the patient remains clinically stable (grade D).

If a patient requires oxygen therapy to be restarted at a higher concentration than before to maintain the same target saturation range, the patient should have a clinical review to establish the cause for this deterioration (grade D).

Some patients may have episodic hypoxaemia (e.g., after minor exertion or due to mucus plugging) after they have safely discontinued oxygen therapy. An ongoing prescription for a target saturation range will allow these patients to receive oxygen as the need arises but transient asymptomatic desaturation does not require correction (grade D).

Practical Aspects of Oxygen Use in Prehospital and Hospital Care and Use of Oxygen Alert Cards (see sections 9–11 in the original guideline document)

Emergency oxygen should be available in primary care medical centres, preferably using oxygen cylinders with integral high-flow regulators. Alternatively, oxygen cylinders fitted with high-flow regulators (delivering up to 15 L/min) must be used to allow use with reservoir masks (grade D). Healthcare organisations should take measures to eliminate the risk of oxygen tubing being connected to the incorrect wall oxygen outlet or to outlets that deliver compressed air or other gases instead of oxygen. Air flow meters should be removed from the wall sockets or covered with a designated air outlet cover when not in use. Special care should be taken if twin oxygen outlets are in use (grade D).

Good Practice Points Related to Practical Aspects of Oxygen Therapy

Assessment and Immediate Oxygen Therapy

Chronically hypoxaemic patients with a clinical exacerbation associated with a 3% or greater fall in oxygen saturation on their usual oxygen therapy should usually be assessed in hospital with blood gas estimations. PaO_2 of <7 kPa equates to SpO_2 below ~85%.

The initial oxygen therapy to be used in the various clinical situations is given in tables 1-4 in the original guideline document.

If there is a clear history of asthma or heart failure or other treatable illness, appropriate treatment should be instituted in accordance with guidelines or standard management plans for each disease. The oxygen saturation should be monitored continuously until the patient is stable or arrives at hospital for a full assessment. The oxygen concentration should be adjusted upwards or downwards to maintain the target saturation range.

In most emergency situations oxygen is given to patients immediately without a formal prescription or drug order. The lack of a prescription should never preclude oxygen being given when needed in an emergency situation. However, a subsequent written record must be made of what oxygen therapy has been given to every patient (in a similar manner to the recording of all other emergency treatment).

General practitioners (GPs) or first responders visiting a patient's home should carry a portable pulse oximeter to assess hypoxaemia and guide use of oxygen if available and should call emergency services if hypoxaemia or other serious illness is suspected.

Those attending patients as an emergency in rural or remote areas should consider carrying a portable oxygen cylinder as part of their emergency equipment.

Oxygen Alert Cards for Patients with Hypercapnic Respiratory Failure

Patients with COPD (and other at-risk conditions) who have had an episode of hypercapnic

respiratory failure should be issued with an oxygen alert card (see the "Availability of Companion Documents" field), and with a 24% or 28% Venturi mask. They should be instructed to show the card to the ambulance crew and emergency department staff in the event of an exacerbation.

Oxygen alert cards with agreed content can be obtained via the BTS Web site.

The content of the alert card should be specified by the physician in charge of the patient's care, based on previous blood gas results.

The primary care team and ambulance service should also be informed by the hospital COPD team that the patient has had an episode of hypercapnic respiratory failure and carries an oxygen alert card. The home address and ideal oxygen concentration or target saturation ranges of these patients can be flagged in the ambulance control systems and information disseminated to ambulance crews when required.

When possible, out-of-hours services providing emergency primary care services should be informed by the hospital COPD team or by the primary care team that the patient has had an episode of hypercapnic respiratory failure and carries an oxygen alert card. Use of oxygen in these patients will be guided by the instructions on the alert card or by a patient-specific protocol which can be shared by hospital teams, the ambulance service and the primary care team.

Practical Aspects of Oxygen Dispensing, Documentation and Monitoring

Registered nurses and others who dispense drugs in hospitals should sign the drug chart or electronic prescribing record at every drug round and check that the patient is receiving oxygen therapy. This is to check that the patient is within the target saturation and also to check whether weaning and discontinuation should be instituted (grade D).

Most patients are prescribed an oxygen target range. If patients are on air at the time of the drug round, registered nurses should sign the drug chart using a code such as 'A' for air and the observation chart should also be filled in using the code A for air (see table 5 and figure 19 in the original guideline document) (grade D).

All patients should have their oxygen saturation observed for at least 5 min after starting oxygen therapy or for patients who require an increased concentration of oxygen and after oxygen therapy has been decreased or stopped (grade D).

If the oxygen saturation is above the target saturation range and the patient is stable, the delivery system or oxygen flow rate should be modified to return the saturation to within the target range (grade D).

Patients who have a target saturation of 88% to 92% should have their blood gases measured within 30 to 60 min. This is to ensure that the carbon dioxide level is not rising. This recommendation also applies to those who are at risk of developing hypercapnic respiratory failure but who have a normal PCO₂ on the initial blood gas measurement (grade D).

Stable patients whose oxygen saturation is within their target saturation range of 94% to 98% do not need repeat blood gas measurements within 30 to 60 min if there is no risk of hypercapnic respiratory failure and acidosis and may not need any further blood gas measurements unless there should be further deterioration including symptoms or signs of possible hypercapnia (grade D).

Stable patients on oxygen treatment should have SpO₂ and physiological variables (e.g., NEWS) measured four times a day (grade D).

In those who have signs of critical illness (e.g., NEWS 7 or above), oxygen saturation should be monitored continuously and the patient may require level 2 or 3 care on a HDU or critical care unit (grade D).

If the patient is clinically stable and the oxygen saturation is within the target range, treatment should be continued (or eventually lowered) depending on the clinical situation (grade D).

Oxygen therapy should be increased if the saturation is below the desired range and decreased if the saturation is above the desired range (and eventually discontinued as the patient recovers) (grade D).

The new saturation (and the new delivery system) and flow rate should be recorded on the patient's observation chart after 5 min of treatment at the new oxygen concentration. Each change should be recorded by the clinician trained to administer oxygen by signing the observation chart (only changes should be signed for) (grade D).

Repeat blood gas measurements are not required for stable patients who require a reduced concentration of oxygen (or cessation of oxygen therapy) to maintain the desired target saturation (grade D).

Patients with no risk of hypercapnic respiratory failure do not always need repeat blood gas measurements after an increase in oxygen concentration. However, the patient requires clinical review to determine why the oxygen saturation has fallen (grade D).

Patients at risk of hypercapnic respiratory failure (usually those with a target range of 88% to 92%; see table 4 in the original guideline document) require repeat blood gas *assessment* 30 to 60 min after an increase in oxygen therapy (to ensure that the carbon dioxide level is not rising) (grade D). For patients with no risk of hypercapnic respiratory failure, monitoring by pulse oximeter is sufficient (repeated blood gases not required) provided the patient is clinically stable and the oxygen saturation remains in the desired range, usually 94% to 98% (grade D).

If a patient's oxygen saturation is lower than the prescribed target range, first check all aspects of the oxygen delivery system and the oximeter device for faults or errors (grade D).

If a patient's oxygen saturation is consistently lower than the prescribed target range, there should be a medical review and the oxygen therapy should be increased according to an agreed written protocol (grade D).

If the oxygen saturation fails to rise following 5 to 10 min of increased oxygen therapy or if there is clinical concern following medical review, then blood gas measurements should be repeated (grade D).

Training in Oxygen Prescribing and Use

All clinicians prescribing oxygen should have appropriate training and access to written or electronic oxygen prescribing guidelines based on this national guideline (grade D). (Training slides for doctors and nurses are available as online appendices 7 and 8 on the BTS website [see the "Availability of Companion Documents" field]).

Every hospital should have a training programme to ensure that clinical staff are familiar with the hospital's oxygen administration policies. In view of the high number of adverse incidents related to oxygen therapy, it is recommended that all acute Trusts should include basic training in oxygen use in the mandatory training programmes for all clinical staff (grade D).

Definitions

Scottish Intercollegiate Guidelines Network (SIGN) Levels of Evidence

Grade	Evidence
1++	High-quality meta-analyses, systematic reviews of randomised controlled trials (RCTs), or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews or RCTs with a low risk of bias
1	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High-quality systematic reviews of case-control or cohort studies High-quality case-control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well-conducted case-control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case-control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, for example, case reports, case series
4	Expert opinion

SIGN Grades of Recommendations

Grade	Type of Evidence
A	At least one meta-analysis, systematic review, or RCT rated as 1++ and directly applicable to the target population <i>or</i> A body of evidence consisting principally of studies rated as 1+ directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results <i>or</i> Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results <i>or</i> Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4 <i>or</i> Extrapolated evidence from studies rated as 2+
Good Practice Point	Recommended best practice based on the clinical experience of the Guideline Development Group

Clinical Algorithm(s)

An algorithm titled "Chart 1 - Oxygen prescription for acutely hypoxaemic patients in hospital" is provided in the original guideline document.

Scope

Disease/Condition(s)

Any condition requiring supplemental oxygen

Guideline Category

Evaluation

Management

Treatment

Clinical Specialty

Critical Care

Emergency Medicine

Internal Medicine

Obstetrics and Gynecology

Pulmonary Medicine

Intended Users

Advanced Practice Nurses

Allied Health Personnel

Emergency Medical Technicians/Paramedics

Health Care Providers

Hospitals

Nurses

Pharmacists

Physical Therapists

Physician Assistants

Physicians

Respiratory Care Practitioners

Guideline Objective(s)

To make oxygen use in emergency and healthcare settings safer, simpler and more effective

Target Population

Adult patients in the prehospital and hospital setting and in other settings such as palliative care:

- Critically ill patients,
- Hypoxaemic patients and patients at risk of hypoxaemia,
- Non-hypoxaemic patients who may benefit from oxygen (e.g., carbon monoxide poisoning)

Note: The present guideline applies only to patients aged >16 years.

Interventions and Practices Considered

1. Achieving desirable oxygen saturation ranges in acute illness
2. Clinical and laboratory assessment of hypoxaemia and hypercapnia
3. Measurement of arterial and capillary blood gases
4. Oxygen therapy
 - Initial oxygen therapy; initial choice of equipment for patients who do not have critical illness
 - In critical illness
 - For specific conditions that frequently require oxygen therapy
 - During pregnancy
 - In perioperative care and during procedures requiring conscious sedation
 - In palliative care
 - Mixtures of oxygen with other gases (Heliox and Entonox)
 - Continuous positive airway pressure (CPAP) and humidified high-flow nasal oxygen
 - Patients with tracheostomy or laryngectomy
 - Humidification of oxygen
 - Driving gas for nebulised treatments
 - Prescribing oxygen therapy
 - Monitoring and adjusting oxygen therapy
 - Weaning and discontinuation of oxygen therapy
 - Practical aspects of oxygen use in prehospital and hospital care and use of oxygen alert cards

- Practical aspects of oxygen dispensing, documentation and monitoring
5. Training in oxygen prescribing and use

Major Outcomes Considered

- Improved oxygenation
- Target saturation ranges
- Adverse effects and clinical risks of oxygen therapy
- Quality of life

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

A MEDLINE search for 'oxygen' yielded over a quarter of a million 'hits', most of which were not relevant to this guideline. For this reason, the British Thoracic Society (BTS) commissioned the Centre for Reviews and Dissemination and Centre for Health Economics at the University of York to undertake bespoke literature searches based on the literature search strategies employed for the 2008 guideline. The search strategies and initial results are shown in detail in Web Appendix 1 (see the "Availability of Companion Documents" field).

The following inclusion/exclusion criteria were applied:

Include:

- The study concerned addresses the clinical question
- Study type appropriate to provide evidence to address the clinical question

Exclude:

- Review articles and conference abstracts
- Abstract not in the English language
- The study concerned does not answer the clinical question concerned
- Study type not appropriate to provide evidence to address the clinical question

Further references were obtained from the group's personal literature collections and from the references contained within the papers which the search yielded and by focused literature searches by members of the guideline group. The group continued to monitor the literature up to the end of 2016 for important new publications or very high-quality abstracts from international meetings that were thought to be relevant to this guideline.

Number of Source Documents

Initial results of the literature searches are provided in Web Appendix 1 (see the "Availability of Companion Documents" field). There were 187 papers included from the initial literature searches and a

further 31 identified from the follow up searches.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Scottish Intercollegiate Guidelines Network (SIGN) Levels of Evidence

Grade	Evidence
1++	High-quality meta-analyses, systematic reviews of randomised controlled trials (RCTs), or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews or RCTs with a low risk of bias
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2+	Well-conducted case-control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case-control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, for example, case reports, case series
4	Expert opinion

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Members of the Guideline Development Group worked in pairs to assign a Scottish Intercollegiate Guidelines Network (SIGN) level of evidence to all of the papers that were judged to be relevant to the guideline (see the "Rating Scheme for the Strength of the Evidence" field).

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

Establishment of Guideline Team

The need for a national guideline for emergency oxygen use was recognised by the British Thoracic Society (BTS) Standards of Care Committee in 2003. A working party was established with representatives from a wide range of professions involved in oxygen therapy and a lay representative. The original group was expanded in 2006 because it became clear that the development and implementation of a national guideline would require input from a very wide range of professional groups. This group agreed the remit

of the 2008 guideline and a series of key questions which were addressed within the 2008 guideline. The group membership was expanded further and the remit was expanded for the 2016 update of the guideline. A full list of guideline group members is provided in annex 1 of the original guideline document.

The methodology for the 2016 guideline adheres to the BTS Guideline Production Manual 2014 (see the "Availability of Companion Documents" field) which is aligned to the Appraisal of Guidelines Research and Evaluation (AGREE) criteria for guideline production.

How the Evidence Was Assimilated into the Guideline

The search strategy and guideline methodology for the 2008 guideline are described within that guideline. The remit of the guideline was widened for this update. Significant new areas include the use of oxygen during conscious sedation procedures, the non-emergency use of oxygen in healthcare settings and the use of continuous positive airway pressure (CPAP), Heliox and oxygen–nitrous oxide mixtures. (Refer to section 2.2 in the original guideline document for a summary of the key questions addressed for this guideline.) The methodology used for the current guideline was based on Scottish Intercollegiate Guidelines Network (SIGN) methodology as outlined in the BTS Guideline Production Manual 2014.

The 2008 guideline had used National Institute for Health and Care Excellence (NICE) levels of evidence so all searches were rerun in November 2011 and again in August 2013. All abstracts retrieved by the literature search were screened by pairs of members and reprints of all relevant papers were obtained. Members of the Guideline Development Group worked in pairs to assign a SIGN level of evidence to all of the papers that were judged to be relevant to the guideline (see "Rating Scheme for the Strength of the Evidence" field).

The group was divided into subgroups to work on each chapter of the guideline. Contributions by each member of the group are acknowledged in annex 1 of the original guideline document. The Guideline Development Group corresponded by email on a regular basis to discuss the evidence and to update the guideline and its key recommendations over the course of 2011–2016. Oxygen therapy is unusual insofar as there are very few published trials where different levels of oxygen therapy have been compared in randomised studies which reported clinically relevant outcomes. Most advice concerning oxygen therapy is based on expert opinion guided by extrapolation from non-interventional studies that do not directly address guideline questions. For this reason, most of the recommendations in this guideline are at grade D and it is hoped that the deficiency of relevant evidence will stimulate researchers to conduct randomised trials of oxygen therapy. However, the fact that a recommendation is graded as 'grade D' due to lack of evidence does not imply that the recommendation is not important or that there is any uncertainty as to the correct course of action. For example, it would never be ethical to undertake a randomised controlled trial (RCT) of oxygen therapy in severe hypoxaemia, so the advice to use oxygen to correct severe hypoxaemia will always be a grade D recommendation but it is one of the most important recommendations in this guideline.

Meetings of the full group were held in November 2011 and September 2012.

Rating Scheme for the Strength of the Recommendations

Scottish Intercollegiate Guidelines Network (SIGN) Grades of Recommendations

Grade	Type of Evidence
A	At least one meta-analysis, systematic review, or RCT rated as 1++ and directly applicable to the target population <i>or</i> A body of evidence consisting principally of studies rated as 1+ directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results <i>or</i>

Grade	Type of Evidence
C	Extrapolated evidence from studies rated as 1++ or 1+ A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results <i>or</i> Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4 <i>or</i> Extrapolated evidence from studies rated as 2+
Good Practice Point	Recommended best practice based on the clinical experience of the Guideline Development Group

Cost Analysis

In addition to the clinical consequences of underassessment, two studies have reported that the availability of a pulse oximeter was highly cost-effective because the finding of normal oximetry (>94%) in many patients allowed paramedics to use oxygen less frequently with a potential financial saving of up to \$2324 (~£1200) per ambulance per annum.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

The updated guideline was reviewed by the British Thoracic Society (BTS) Standards of Care Committee in September 2014, March 2015, September 2015 and June 2016. The guideline was further refined by email discussion following comments by this committee. The draft was made available via the BTS Web site for 6 weeks from 7 December 2015 to 18 January 2016 for public and stakeholder consultation and comments were invited. The draft document was sent to two peer reviewers at that time. The revised document was then submitted to BTS for final approval in October 2016 and endorsement invited from the other stakeholder societies and colleges.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field). Most advice concerning oxygen therapy is based on expert opinion guided by extrapolation from non-interventional studies that do not directly address guideline questions. For this reason, most of the recommendations in this guideline are at grade D and it is hoped that the deficiency of relevant evidence will stimulate researchers to conduct randomized trials of oxygen therapy.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

- Most guidelines for CPR and the care of patients with critical illness recommend the use of the highest feasible oxygen concentration in the initial stages of resuscitation. Although these recommendations are not evidence-based, it is unlikely that controlled trials would ever be undertaken using different levels of oxygen therapy in these emergencies and it seems intuitive to maximise oxygen delivery for critically ill patients with circulatory collapse and respiratory failure. However, randomised trials have been undertaken of resuscitation of neonates breathing room air or oxygen and the unexpected outcome of a Cochrane review was that the survival was better when room air was used. This surprising finding cannot be extrapolated to adult patients, but it does emphasise the need for clinical trials even in areas where one might intuitively believe that oxygen would be beneficial. Furthermore, there is theoretical evidence that patients who have had a restoration of spontaneous circulation after cardiac arrest may be managed more safely with <100% inspired oxygen.
- It has been shown that early intervention to increase oxygen delivery to the tissues in critically ill patients as well as high-risk surgical patients reduces organ failure reduces length of intensive care unit (ICU) stay and, most importantly, improves survival. Increased oxygen delivery in part involves oxygen therapy, but these studies did not show any benefit from aiming at supraphysiological oxygen delivery.
- Reported benefits of oxygen therapy in healing of established wounds and in treatment of wound sepsis are controversial. Hyperbaric oxygen reduced the risk of amputation in patients with chronic diabetic foot ulcers and may improve the chance of healing over 1 year, but the Cochrane reviewers had concerns about the size and quality of existing studies and recommended further trials. It is not known if conventional oxygen therapy has any effect on wound healing.
- The potential benefit of oxygen for prevention of postoperative wound infection is discussed in section 8.15.3 in the original guideline document.
- Through relief of breathlessness and work of breathing, oxygen therapy may decrease carbon dioxide production and consequently offset some of the potential increase in arterial oxygen tension (PaO_2) that might otherwise occur due to the mechanisms described in section 6.3.1 in the original guideline document. However, there are no controlled trials supporting the use of oxygen for this indication.
- For some conditions such as advanced pulmonary fibrosis requiring palliative care, the potential benefits of oxygen for non-hypoxaemic patients at rest have not been addressed in clinical trials although many patients with this condition desaturate on exertion and benefit from ambulatory oxygen therapy. See the NGC summary of the [British Thoracic Society guidelines for home oxygen use in adults](#) for guidance about the medium-term use of oxygen by patients in the home setting.
- Relief from cluster headache with oxygen therapy has been reported in 56% to 85% of cases. Benefit has recently been reported for other types of headache.
- Two meta-analysis studies and one large randomized controlled trial (RCT) have provided evidence that continuous positive airway pressure (CPAP) administered with supplemental oxygen has definite measurable physiological and short-term clinical benefits in pulmonary oedema. The longer term benefits are less clear, in particular any reduction in mortality. The meta-analysis and prehospital RCT looking at use of CPAP suggest reduced mortality and/or intubation rates. However, this mortality benefit was not found in the largest and best constructed RCT. In addition, this study did not report a reduction in the number of intubations.

Potential Harms

- While the administration of oxygen to the hypoxaemic patient leads to an increase in arterial oxygen tension (PaO_2) which leads to favourable physiological effects and ultimately the prevention of cell death, administering oxygen to the non-hypoxaemic patient has other physiological effects which are not widely appreciated, although how important these are clinically is not clear in most cases. These potentially adverse effects include direct pulmonary toxicity, coronary vasoconstriction, decreased cardiac output, increased free radical generation and the potential to delay the recognition of physiological deterioration due to the masking of any desaturation. These risks are discussed in

detail in section 6 of the original guideline document.

- In one study, the commonest side effect of Entonox was dizziness which affected 39% of those given nitrous oxide and none of the control participants. The main side effect is drowsiness and if the patient takes too much, because they are holding the mask to their face, the mask will slip off and the patient returns to breathing ambient air again. The rapid washout of nitrous oxide means that the patient regains consciousness very quickly.
- Significant caution should be taken with both the administration of sedation and supplemental oxygen in patients with known resting hypercapnia or significant lung disease who are at risk of hypercapnic respiratory failure. It is crucial to ensure sufficient clinical assessment of patients at all times.
- Caution should be exercised when administering oxygen to all morbidly obese patients even those without a diagnosis of sleep-disordered breathing. One study of 40 morbidly obese patients undergoing laparoscopic bariatric surgery showed the incidence of postoperative hypoxaemia was as high in patients without obstructive sleep apnea (OSA) compared with those with a diagnosis of OSA and supplemental oxygen did not reduce the frequency of oxygen desaturations.
- The authors of this guideline recommend that oxygen should be administered only to correct hypoxaemia. Particular caution is advised in patients who may be prone to carbon dioxide retention and the use of transcutaneous CO₂ monitoring in these patients has been suggested.

Contraindications

Contraindications

- Entonox is less dense than air and may expand in air filled cavities, and as such, is contraindicated in patients with known emphysema. There is a concern of course that if Entonox is used in patients who are at risk of hypercapnic respiratory failure, the high concentration of oxygen may precipitate hypercapnia. Again, if the patient does become drowsy because of hypercapnia or the sedating effect of Entonox, they may release the mask and return to breathing air again. Unfortunately, if the patient has a cause for hypoxaemia, this will result in swinging from hyperoxaemia to hypoxaemia. Thus for this reason, the guideline group advise that Entonox is best avoided in patients who are at risk of hypercapnia or hypoxaemia.
- Oxygen must not be used near a naked flame or source of heat.

Qualifying Statements

Qualifying Statements

Healthcare providers need to use clinical judgement, knowledge and expertise when deciding whether it is appropriate to apply recommendations for the management of patients. The recommendations cited here are a guide and may not be appropriate for use in all situations. The guidance provided does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of each patient, in consultation with the patient and/or their guardian or carer.

Limitations of the Guideline

This guideline is based on the best available evidence concerning oxygen therapy. However, a guideline can never be a substitute for clinical judgement in individual cases. There may be cases where it is appropriate for clinicians to act outwith the advice contained in this guideline because of the needs of individual patients, especially those with complex or interacting disease states. Furthermore, the responsibility for the care of individual patients rests with the clinician in charge of the patient's care and the advice offered in this guideline must, of necessity, be of a general nature and should not be relied on

as the only source of advice in the treatment of individual patients. In particular, this guideline gives very little advice about the management of the many medical conditions that may cause hypoxaemia (apart from the specific issue of managing the patients' hypoxaemia). Readers are referred to other guidelines for advice on the management of specific conditions such as chronic obstructive pulmonary disease (COPD), pneumonia, heart failure, etc. Some of these disease-specific guidelines may suggest slightly different approaches to emergency oxygen therapy whereas the present guideline aims to provide simple all-embracing advice about oxygen therapy.

Implementation of the Guideline

Description of Implementation Strategy

Dissemination

Dissemination of this guideline will be encouraged and supported strongly by the societies involved in the production of the guideline.

Local Guidelines

It is recognised that many healthcare organisations tend to modify national guidelines for local use. Summaries of the guideline for acute hospitals, ambulance services and general practice are shown in appendices 3 and 5 (see the "Availability of Companion Documents" field). Educational materials are available as appendices 7 and 8. It is hoped that the shortened version of this guideline (or a customised local version) will be made available on the web site of every National Health Service (NHS) Trust.

Local Oxygen Policy

It is usual for a new policy to be presented to the local policy committee. A specimen example of a local policy is available in web appendix 4 to help with the production of this policy in individual healthcare organisations.

Oxygen Prescription Chart

Implementation of the guideline requires an 'oxygen section' in the prescription chart or in the electronic prescribing record in all hospitals. A specimen example is available in figure 19 in the original guideline document. From experience, it is recommended that oxygen should be placed at the start of the prescription chart because all hospital patients need a specified target saturation range. The oxygen prescription may be missed if it is placed in another part of the drug chart.

Staff Education

Medical staff education is fundamental to the success of this guideline. Teaching slides are available on the British Thoracic Society (BTS) web site. It is thought that these are suitable for FY1, FY2 and specialty trainees. They are also suitable for undergraduate medical education. Nursing staff and nursing students also require education as do physiotherapists, pharmacists, midwives and other clinicians including healthcare assistants and other unregistered staff who may assist in the care of patients who are using supplemental oxygen. Slide sets have also been produced for this purpose and are available on the BTS web site. It is suggested that small groups of 5 to 10 nurses from wards are taught in sessions lasting 30 min each day before the introduction of the guideline locally. This has been found to be more successful than relying on training days as this would take too long to train enough staff adequately.

Local Champions

Local champions in hospitals, Primary Care Trust (PCT) providers, and ambulance services who helped to introduce these guidelines. The Guideline Development Group are very grateful to the local oxygen champions for organising the introduction of local oxygen policies in 89% of UK acute hospital Trusts by

2011. In most instances, the oxygen champions have introduced a new prescription chart and helped to organise staff education. Clinical governance leads will also need to become committed to the implementation of the Emergency Oxygen Guideline and audit of this process.

Benefits of Nationwide Implementation

One major benefit of nationwide implementation is that, when staff transfer between organisations, they will be familiar with the oxygen prescription and administration system.

See web Appendix 11 (see the "Availability of Companion Documents" field) for additional information on dissemination and implementation.

Implementation Tools

Clinical Algorithm

Patient Resources

Quick Reference Guides/Physician Guides

Slide Presentation

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

End of Life Care

Getting Better

IOM Domain

Effectiveness

Patient-centeredness

Safety

Identifying Information and Availability

Bibliographic Source(s)

O'Driscoll BR, Howard LS, Earis J, Mak V, British Thoracic Society Emergency Oxygen Guideline Group, BTS Emergency Oxygen Guideline Development Group. BTS guideline for oxygen use in adults in healthcare and emergency settings. *Thorax*. 2017 Jun;72(Suppl 1):ii1-ii90. [494 references] [PubMed](#)

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

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Guideline Developer(s)

British Thoracic Society - Medical Specialty Society

Source(s) of Funding

The Society does not seek or accept external funding for the production of its guidance.

Guideline Committee

British Thoracic Society Emergency Oxygen Guideline Development Group

Composition of Group That Authored the Guideline

Guideline Development Group Members: B R O'Driscoll, Respiratory Medicine, Salford, Royal Foundation NHS Trust, Salford, UK, and Manchester Academic Health Sciences Centre (MAHSC), Manchester, UK; L S Howard, Hammersmith Hospital, Imperial College Healthcare NHS Trust, London, UK; J Earis, University of Liverpool, Liverpool, UK; V Mak, Imperial College Healthcare NHS Trust, London, UK, on behalf of the British Thoracic Society Emergency Oxygen Guideline Group

Financial Disclosures/Conflicts of Interest

Declarations of Interest

All members of the guideline group made declarations of interest in line with British Thoracic Society (BTS) policy and further details can be obtained on request from BTS.

Competing Interests

LH has received research funding support from Bayer PLC. VM has received lecture and meeting attendance support from Chiesi, GSK and AstraZeneca.

Guideline Endorser(s)

Association for Palliative Medicine of Great Britain and Ireland - Medical Specialty Society

Association for Respiratory Technology and Physiology - Professional Association

Association of British Neurologists - Clinical Specialty Collaboration

Association of Chartered Physiotherapists in Respiratory Care - Professional Association

Association of Respiratory Nurse Specialists - Professional Association

British Association of Stroke Physicians - Clinical Specialty Collaboration

British Geriatrics Society - Medical Specialty Society

College of Paramedics - Clinical Specialty Collaboration

Intensive Care Society - Professional Association

Joint Royal Colleges Ambulance Liaison Committee - Clinical Specialty Collaboration

Primary Care Respiratory Society - UK - Medical Specialty Society

Resuscitation Council (UK) - Disease Specific Society

Royal College of Anaesthetists - Medical Specialty Society

Royal College of Emergency Medicine - Medical Specialty Society

Royal College of General Practitioners - Medical Specialty Society

Royal College of Nursing - Professional Association

Royal College of Obstetricians and Gynaecologists - Medical Specialty Society

Royal College of Physicians - Medical Specialty Society

Royal College of Physicians and Surgeons of Glasgow - Clinical Specialty Collaboration

Royal College of Physicians of Edinburgh - Clinical Specialty Collaboration

Royal Pharmaceutical Society - Clinical Specialty Collaboration

The Society for Acute Medicine - Disease Specific Society

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Available from the [British Thoracic Society \(BTS\) Web site](#) .

Availability of Companion Documents

The following are available:

British Thoracic Society. Web appendix 1: literature search strategy. London (UK): British Thoracic Society; 2017 May. 15 p. Available from the [British Thoracic Society \(BTS\) Web site](#) .

British Thoracic Society. Web appendix 2: evidence tables. London (UK): British Thoracic Society; 2017 May 11. 6 p. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 3: summary of guideline for hospital use. London (UK): British Thoracic Society; 2017 May. 1 p. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 4: local oxygen policy template. London (UK): British Thoracic Society; 2017 May. 36 p. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 5: summary of guideline and flow charts for emergency oxygen use in ambulances, community and pre-hospital settings. London (UK): British Thoracic Society; 2017 May. 3 p. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 7: teaching slides for doctors. London (UK): British Thoracic Society; 2017 May. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 8: teaching slides for nurses and PAMs. London (UK): British Thoracic Society; 2017 May. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 9: key points for hospital managers and oxygen champions. London (UK): British Thoracic Society; 2017 May. 1 p. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 10: key points for Primary Care Trust managers, practice based commissioning groups and general practice managers. London (UK): British Thoracic Society; 2017 May. 1 p. Available from the [BTS Web site](#) .

British Thoracic Society. Web appendix 11: dissemination and implementation of the guideline. London (UK): British Thoracic Society; 2017 May. 8 p. Available from the [BTS Web site](#) .

British Thoracic Society. Oxygen alert card template. 2017 May. 1 p. Available from the [BTS Web site](#) .

British Thoracic Society Standards of Care Committee guideline production manual 2016 version. London (UK): British Thoracic Society; 2016. 42 p. Available from the [BTS Web site](#) .

Audit criteria are provided in section 13 of the original guideline document.

Patient Resources

The following is available:

British Thoracic Society. Web appendix 6: patient information sheet: emergency oxygen therapy. London (UK): British Thoracic Society; 2017 May. 2 p. Available from the [British Thoracic Society \(BTS\) Web site](#) .

Please note: This patient information is intended to provide health professionals with information to share with their patients to help them better understand their health and their diagnosed disorders. By providing access to this patient information, it is not the intention of NGC to provide specific medical advice for particular patients. Rather we urge patients and their representatives to review this material and then to consult with a licensed health professional for evaluation of treatment options suitable for them as well as for diagnosis and answers to their personal medical questions. This patient information has been derived and prepared from a guideline for health care professionals included on NGC by the authors or publishers of that original guideline. The patient information is not reviewed by NGC to establish whether or not it accurately reflects the original guideline's content.

NGC Status

This NGC summary was completed by ECRI Institute on September 15, 2017. The information was verified by the guideline developer on November 8, 2017.

This NEATS assessment was completed by ECRI Institute on September 7, 2017. The information was verified by the guideline developer on November 8, 2017.

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